

Graphical User Interface Screens

Work Order Entry and List

Work Order Entry

Sales Order Number :	66110-P-517-01	Serial Number :	6006528
Unit :	1	Rev No./DQM No :	-
Object :	50 MVA, 3 phase, 420 kV, Shunt Re	Root 3 :	1.732 <input type="checkbox"/> Conduct Partial Discharge on IEC Standard
Customer :	M/s PGCIL Shunt Reactor	M/s PGCIL	
LAO Ref No. :	C-14005-S119A-7/LOA-I/2250 DATED 22 /12 /2006		
Ref. Standard :	IS:2026	Type Of Transformer :	SR
Other Std. :	-	Ref. :	CG/2011/2012/3/683
Type of Inspection :	Final Inspection	Issue Date :	23/06/2008
Approved By :	A.K.Singh	Sr. Manager TTG	Testing date : 16 th 22 nd August 2008
Witnessed By-Name :	Customer 1	Customer 2	Customer 3
Designation :	Designation	Designation	Designation
Performance :	The Reactor meets the contractual / guaranteed performance satisfactorily		
Transformer Make :	-		
Job Type :	Manufacturer	Select Rating :	MVA
Note :	Note 1: The test certificate relates only to the item tested. Note 2: The certificate shall not be reproduced except in full, without the written permission of TTG, BHEL, Bhopal		

Tested By :
(P M Mathai), Manager TTG



Transformer Rating Data Sheet

Transformer Rating 1 **Transformer Rating 2**

Design Parameters

Phase(s) : Three | Type : Single Winding | Vector : Select One

Winding Designation : Primary : HV | Secondary : - | Tertiary :

Terminal Notation : U V W N | | | | | | | |

Rated Capacity and Type of Cooling MVA

	MVA	MVA	MVA
ONAN	50	0	0
	0	0	0
	0	0	0
	0	0	0

Rated Parameters

	Dual Volt		Dual Volt		Dual Volt	
Rated Voltage(kV) :	420	0	0	0	0	0
Rated Current(A) :	68.73	0	0	0	0	0
Connection(s) :	Three Phase					

Frequency(Hz) : 50 | Voltage Class : 420 kV

Winding Material : COPPER | Ref. Temp. [°C] : 75

Test Performed

Test Date 21/06/2012


- MEASUREMENT OF WINDING RESISTANCE
- MEASUREMENT OF INSULATION RESISTANCE
- SEPARATE SOURCE VOLTAGE WITHSTAND TEST
- SWITCHING IMPULSE VOLTAGE WITHSTAND TEST
- LIGHTNING IMPULSE VOLTAGE WITHSTAND TEST
- MEASUREMENT OF LOAD LOSS AND IMPEDANCE VOLTAGE
- TEMPRATURE RISE TEST
- MEASUREMENT OF CAPACITANCE AND DISSIPATION FACTOR
- MEASUREMENT OF ACOUSTIC NOISE LEVEL
- DGA TEST ON OIL
- MEASUREMENT OF ZERO PHASE SEQUENCE IMPEDANCE
- ISOLATION TEST
- INDUCED OVER VOLTAGE WITHSTAND TEST WITH PARTIAL DISCHARGE MEASUREMENT
- SUMMARY OF TESTS

Summary of Test Results Load Loss report with Annexure Add Annexure in index page

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Measurement of Winding Resistance

Unit : **Ohms** Test Date : 05/05/2012

Top Oil Temp. [°C]  Avg. Oil Temp. [°C]
 Bottom Oil Temp. [°C] Winding under Test

HV (420 kV)					
Tap No.	U-N	V-N	W-N	Avg. Resist. at 35 °C	Resistance at 75 °C
-	3.0020	3.0040	2.9090	2.971667	3.411914

SelectChannel

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Measurement of Insulation Resistance of Windings

Test Date 22/08/2008

Insulation Resistance Test

No. of Records [Time] **Manually** Condition **Once** Top Oil Temp. [°C] 36
 Earthing Duration [Sec] **3** Btm. Oil Temp. [°C] 36
 Avg. Oil Temp. [°C] 36 **Acquire**

P.I. Ratio 1 **600/60** **Clear** P.I. Ratio 2 **Ratio** P.I. Ratio 3 **Ratio** Unit **MegaOhms**

Measurement

Wdg. Under Test	HV / Tank + E
Voltage [Volts]	5000

Time (Secs)

15
60
600

Insulation Resistance Values [MegaOhms]

374
776
1640

PI Ratio1	2.11
PI Ratio2	
PI Ratio3	

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Separate Source Voltage WithStand Test

Test Date 18/08/2008

Winding under test	<input checked="" type="checkbox"/> *Um [kV]	Test Voltage [kV]	Test Duration [seconds]	Frequency [Hz]	Remarks
HV Tank + E	420	230	60	50	Withstood

Leakage

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Impulse Voltage WithStand Test

Winding Designation: **HV** | LI Test | SI | Test Date: 21/06/2012

Limb: One Limb | Three Limb | With Instrument | Without Instrument

Rated Voltage [kV]	Test Voltage [kVp]			Waveform T1/T at 90% /T2 at First Zero	Polarity				
	FW	CW	SI						
420	0	0	1050	[Min. 100 / 200 / 1000] μS	[-] Negative				
▶ Test Circuit	Phase - U			Phase - V	Phase - W				
Impulse on	HV - U			HV - V	HV - W				
Transferred Thr	N			N	N				
Earthed via shunt	W & Tank			U, W & Tank	U & Tank				
Earthed directly									
Terminal Open									
Tap Position	no tap			no tap	no tap				
Test Sequence	File Ref.	Voltage		File Ref.	Voltage		File Ref.	Voltage	
			[kV]			[kV]			[kV]
RFW	TEST/P...	75.09	788.4	TEST/P...	74.93	786.80	TEST/P...	74.93	786.8
100FW	TEST/P...	99.62	1046	TEST/P...	100	1050	TEST/P...	100	1050
100FW	TEST/P...	100	1050	TEST/P...	100	1050	TEST/P...	100	1050
100FW	TEST/P...	100	1050	TEST/P...	100	1050	TEST/P...	100	1050

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Impulse Voltage WithStand Test

Winding Designation: **HV** | SI Test FW CW | Test Date: 21/06/2012

Limb: One Limb Three Limb | With Instrument Without Instrument

Rated Voltage [kV]	Test Voltage [kVp]			Waveform T1/T2	Polarity
	FW	CW	SI		
420	1300	0	0	[1.2 ± 0.36 / 50 ± 10] μS	[-] Negative
▶ Test Circuit	Phase - U		Phase - V		Phase - W
Impulse on	HV - U		HV - V		HV - W
Earthed via shunt	N		N		N
Earthed directly	W & Tank		U, W & Tank		U & Tank
Earthed 400 Ohm					
Tap Position	no tap		no tap		no tap
Wave Shape	μs		μs		μs

Test Sequence	File Ref.	Voltage		File Ref.	Voltage		File Ref.	Voltage	
			[kV]			[kV]			[kV]
RFW	TEST/P...	75	975	TEST/P...	74.92	973.90	TEST/P...	74.92	973.90
FW	TEST/P...	100.46	1306	TEST/P...	100.23	1303	TEST/P...	100.08	1301
FW	TEST/P...	100.62	1308	TEST/P...	100.23	1303	TEST/P...	100.23	1303
FW	TEST/P...	100.46	1306	TEST/P...	100.23	1303	TEST/P...	100.08	1301

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Measurement Of Load Loss And Impedance Voltage

CT Ratio
 Mutual Inductance mH
 Capacitance of Standard Capacitor pF
 Frequency Hz
 Guranteed Loss KW(Max)
 Guarenteed Impedance Ω

Note : Temp. co-efficient taken from similar Shunt Reactor W.O.No 64053-A -517-01 , SI no 6006245 for PGCIL

Phase	Test Temp[°C]	Test Voltage [U kV]	Resistance [R4 ,KOhm]	Capacitance [C4 , μF]	X[Ohm]	Test Current[A]	Tan Delta	Loss @ RV
U	33.50	242.77	138.92	11.308	3499.63	69.37	0.002026	34.12
V	33.50	242.77	159.92	11.336	3509.06	69.18	0.0017556	29.49
W	33.50	242.77	301.92	11.32156	3502.77	69.31	0.0009311	15.67

Phase	Temp Coeff	Loss @ RV @75 °C	Loss @ RC @75 °C
U	0.0465	35.39	35.39
V	0.0402	30.76	30.76
W	0.0319	16.71	16.71

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Diagram

Temperature Rise Test


Measurement **Measurement of Resistance** Determination of Temperature Test Date 11/05/2012

Temperature Rise Test Measured Values

OIL TYPE HV/RE/ONAN/50 No Load Loss 0 Test Freq. (Hz) 50 Time 02:02:32

Supply HV Short Circuit RE Load Loss 35.39 Load Fact. Auto Cooler P.A

Short 420 Type of Cooling ONAN/5 Tap Position - Wti/o 0

Total Losses [kW] 35.39 PTR 1  No Cooler

Rated Current [A] CTR 1

Temperature Rise Test Data Log

Input		Ambient Temperature [°C]		Cool Temp [°C]			Temperature [°C]		
Hour	KW	KV	A	t1	t2	t3	TAvg	Top Oil	Top Oil Rise
10:00		420		24.93	24.93	24.93	24.93	28.00	3.07
11:00		420		25.60	25.60	25.60	25.60	29.00	3.40
12:00		420		26.53	26.53	26.53	26.53	33.50	6.97
13:00		420		27.23	27.23	27.23	27.23	37.50	10.27
14:00		420		28.10	28.10	28.10	28.10	40.50	12.40
15:00		420		28.67	28.67	28.67	28.67	43.50	14.83
16:00		420		29.03	29.03	29.03	29.03	46.00	16.97

Ptr/Ctr from Power Analyzer 3P4W

2 Watt Meter

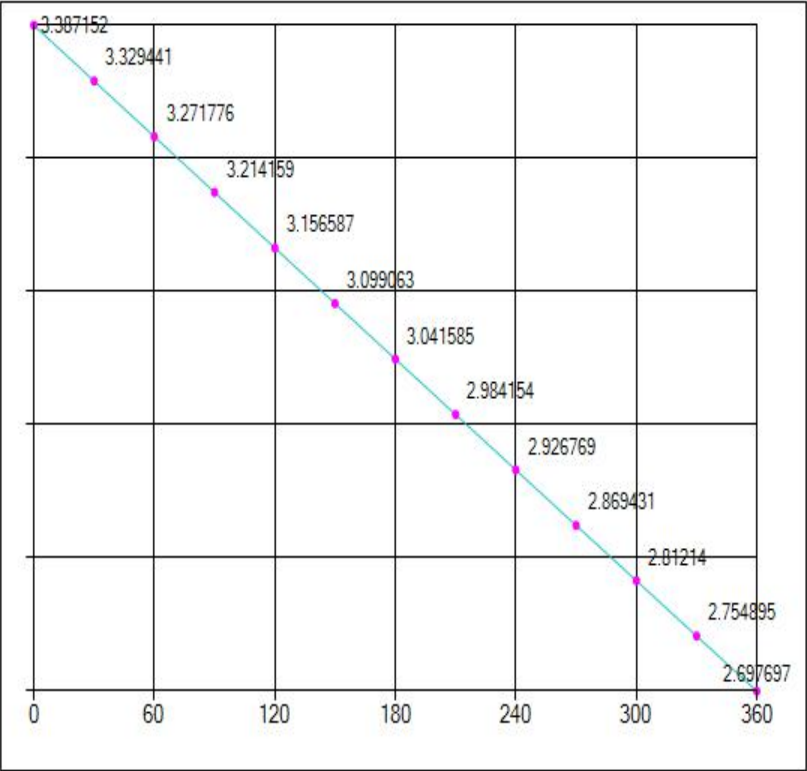
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 Overload
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Temperature Rise Test

Measurement Measurement of Resistance Determination of Temperature Test Date 11/05/2012

Winding HV Tap No. - Cold Resi 3.002 Ohms at 35 °C Interval 30

Min.	Sec.	HV ()	HV Ex.Res [Ohms]
00:00	0		3.387152
00:30	30	3.32	3.329441
01:00	60	3.27	3.271776
01:30	90	3.21	3.214159
02:00	120	3.18	3.156587
02:30	150	3.14	3.099063
03:00	180	3.00	3.041585
03:30	210	2.97	2.984154
04:00	240	2.93	2.926769
04:30	270	2.86	2.869431
05:00	300	2.82	2.812140
05:30	330	2.76	2.754895
06:00	360	2.70	2.697697



+ Add Row
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Extrapolate
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Start Resistance
Log
Acquire data

Save record

Temperature Rise Test

Measurement Measurement of Resistance **Determination of Temperature** Test Date 11/05/2012

Guaranteed

Top Oil Temp Rise [°C] Mean Winding Temp Rise [°C]

Determination of Temperature Rise

	Unit	Shutdown 1
DETERMINATION OF TOP OIL TEMPERATURE RISE		
Reference Power	MVA	
Top Oil Temp. Rise at Total Losses	°C	34.67
DETERMINATION OF WINDING TEMPERATURE RISE		
Ambient Temp at the time of switch off [Th]	°C	28.33
Reference Cold Resistance at [Tc]35[Rc]°C	Ohms	3.002
Winding Resis. at Switchoff from (Cooling Curve)[Rh]	Ohms	3.387152
Winding Temp. at Switchoff	°C	69.64
Winding Temp. Rise	°C	41.31
Correction Factor	°C	0.00
RESULTS		
Top Oil Temperature Rise	°C	34.67
Final Winding Temp. Rise [Wind. Temp. Rise + C.F.]	°C	41.31

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Measurement of Capacitance and Dissipation Factor

Key **W/Once/10** Test Date **22/08/2008**

Winding Bushing **Once**

Avg. Oil Temp. **36** Test Voltage 5 kV 10 kV Factor Edit

C. factor

Phase	Test Mode	Measured Between	Test Volt [kV]	Capacitance pF	Tan Delta [Dissipation Factor] in %	
					36	20° C
▶	UST	U+V+W+N/Ta...	10	8678	0.0034	0.002378

Measurement of Acoustic Noise Level

Test Date 05/05/2012 ▾

Test for
 Meas. in accordance with specification **NEMA-TR1** ▾
 Dist. of microphone from radiating surface [mtr]
 Dist. of microphone bet'w'n two positions [mtr]

Test Conditions:
 Excitation Voltage [kV]
 Test Frequency [Hz]
 Tap Position
 Guranteed Noise level [dB]

Noise level measurement for type of cooling
 ▾ ▾ ▾ ▾

Plan Position	Ambient [1/3 rd]	Ambient [2/3 rd]
1	69.7	71.5
2	73.5	71.6
3	73.7	75.7
4	76	75
5	73.1	72.2
6	76.8	74.1

Test on Transformer OIL

Oil BDV Test/Water Content Test **DGA Test** Other Tests

Summary

Summary

Test Condition	Oil Sample	Oil BDV (kV)	Water Content (ppm)	Tan Delta @ 90 °C	Specific Resistance @ 90 °C ohm-cm	Test Date
BHV ▾	Bottom	76	6.0	0.008	10.2 * (10 ^ 12)	16/08/2008 ▾
AHV ▾	Bottom	75	7.0	0.007	11.5 * (10 ^ 12)	23/08/2008 ▾
	Specified value as per quality plan	>=60	<=10	<=0.01	>=6x(10^-12)	

Interfacial tension before electrical tests in Temp. °C

Measurement Zero Phase Single Impedance

Test Date 21/06/2012

ZPS Test **1W/HV-/ONAN/50/2** Cooling **ONAN** Temperature

Test Between **HV/-** [MVA] **50** Top Oil Temp. [°C] **30**

Supply HV RE Bot. Oil Temp. [°C] **30**

Short Circuited **-** Avg. Oil Temp. [°C] **30**

Open **-** Tap Positions [Load Tap] **-** All Taps

Guar. %vz at [MVA] **50** Tol **±** Test Freq. (Hz) **50**

Tap No. **-** % vz = **-** % Top Oil Temp. **-** PTR **1** CTR **1**

Tap No. **-** % vz = **-** % Bot. Oil Temp. **-** Diagram **-**

Tap No. **-** % vz = **-** %

Tap	Ur	Ir	Constants		Measured		Calculated Parameters					
			PTR	CTR	V rms	CT1	Um	Im	Freq.	Ohms/P	% Z	%
-	420	68.73	1	1	63900	56.25	63.900	56.250	49.7	3428.57	97.176	100

Magnetic Circuit Test

Test Date 22/08/2008

Isolation Test

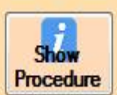
Isolation Test

3.5 KV DC applied for 60 seconds , between core to end frame , core to tank and end frame to tank. The reactor withstood the test satisf

Leakage optional

2kV test with Leakage Current

Check of insulation Resistance Value



Induced over voltage Withstand Test with Partial Discharge Measurement (without line Current)

Test Type : Calibration Phase Selection Test Date 09/05/2012 ▾

pC ▾

U1,U2 ,Um

Terminals		Charge Injected (pC)		Charge Measured (pC)		Calibration Factor (K [*])	
HV		HV		HV		HV	
U		500		50		10.0	
V		500		50		10.0	
W		500		50		10.0	

Measurement InpC

Time In (Minutes)	Test Voltage (kV)	App. Voltage(KV)	Phase 1			Phase 2			Phase 3		
			HV			HV			HV		
	364	0	60	0	0	40	0	0	40	0	0
5	364		50			40			40		
10	364		40			40			40		
15	364		40			40			40		

Background Noise Level Back Ground PD Level <=10 PC

Vibration Level Measurement

Testdate 21-Jun-2012

Procedure Vibration level measurements were carried out on the above reactor on 17.08.2008. The locations of measurements and test results are given below. The job was energized and the rated voltage at the time of measurement. The test was conducted in presence of TTG engineers and customers representative.

Specification 1 Vibration Levels in Microns (Peak to Peak)

Specification 2 Guaranteed value 200 Microns maximum (Peak to Peak)

Specification 3 Average Guaranteed value 60 Microns maximum (Peak to Peak)

LOCATION	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	6	13	16	13	5	30	8	8	5	5	10	14	32	11
2	13	9	13	5	5	28	11	5	10	5	7	14	20	15
3	8	7	17	9	10	32	10	5	5	7	13	32	40	15
4	15	6	30	8	6	27	5	7	5	10	5	20	25	10

Specification 4 Average Guaranteed value 12.95 Microns maximum (Peak to Peak)

Test Result Satisfactory.



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Diagram



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Measurement of Dynamic Stress

Testdate 21-Jun-2012

Procedure Dynamic stress level measurements were carried out on the above reactor on 17.08.2008. The locations of measurements and test results are given below. The job was energized at the rated voltage at the time of measurement. The test was conducted in presence of TTG engineers and customer representatives.

Specification (Guaranteed stress value 20 N/mm² maximum)

Location	Direction	Micro Strain	Stress N/mm ²
L3	Horizontal	1	0.294
L3	Vertical	2	0.588
M3	Horizontal	7	2.058
M3	Vertical	3	0.882

Test Result Satisfactory.



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Del. Row



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Diagram



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Measurement of Impedance by V/I method

Testdate 21-Jun-2012

Rated Current	Measured Current in Amp	Measured Voltage in kV	Measured Frequency in Hz	% Impedance in Ω
10 Ampere	10	4.47	49.4	452.43
60 Ampere	60	26.1	49.3	441.18

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Summary of Test Result

Summary of Test Result I | Temperature Rises | Summary of Test Result II | Efficiency & Regulation | Test Date : 11/05/2012 ▾

Particulars	@Tap No	Guaranteed	Measured	Remark
<input checked="" type="checkbox"/> Loss at 1.0 p.u. current and voltage at 75 °C. kW		85 Max	82.78	Satisfactory
<input checked="" type="checkbox"/> Impedance at rated voltage. O		3528 (+0% to -5% Tol.)	3504.13	Satisfactory
<input checked="" type="checkbox"/> Partial Discharge level. pC		500 Max.	60.00	Satisfactory
<input type="checkbox"/> Load Loss [kW]				
<input type="checkbox"/> Load Loss [kW]				
<input type="checkbox"/> Load Loss [kW]				
<input type="checkbox"/> Load Loss [kW]				
<input type="checkbox"/> Load Loss [kW]				
<input type="checkbox"/> % Impedence [%]				
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